

ON THE PRODUCTION IN AUSTRALIA OF TWO NEW PHYSIOLOGIC FORMS  
OF LEAF RUST OF WHEAT, *PUCCINIA TRITICINA* ERIKSS.

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*Introduction.*

The phenomenon of specialization in the rust fungi has long been known (Eriksson, 1894). Its importance has been realized in more recent times, but only lately has the mode of origin of physiologic forms been investigated.

Craigie (1927) demonstrated that certain rusts are heterothallic, and thus paved the way for experiments on the origin of physiologic forms as a result of rust hybridization. Waterhouse (1929) reported two physiologic forms of *Puccinia graminis tritici* which owed their origin to mixing of the spermatial juices on the barberry. Miss Newton *et al.* (1930) and Stakman *et al.* (1930) have also shown that physiologic forms of *P. graminis tritici* arise as a result of hybridization on the barberry, as well as by mutation. So far no such occurrence has been recorded for *P. triticina*.

*Materials and Methods.*

In November, 1930, dry leaves of wheat heavily infected with the teleutospore stage of the leaf rust were collected at Hawkesbury Agricultural College from a plot where it was known that there were present the two forms previously described (Waterhouse, 1929), and shown in Table I. These leaves were kept in the laboratory throughout the summer. In the autumn they were sent to Bathurst, N.S.W., where Mr. R. E. Dwyer was responsible for exposing the material to the winter weather. In the spring (September, 1931) examinations revealed abundant teleutospore germinations. This was the first occasion in attempts extending over 10 years on which germinations were seen. The success was due to following the suggestion made by Dr. C. O. Johnston of Kansas, U.S.A., to protect the teleutospores from the high summer temperatures which prevail in the field.

Thanks to the courtesy of Dr. G. P. Darnell Smith, Director of the Sydney Botanic Gardens, vigorous plants of *Thalictrum flavum* were obtained for inoculation tests. Young seedling plants of *T. dipterocarpon* were also used for a similar series of tests.

Fragments of the wheat leaves carrying teleutosori were soaked in water for an hour and then placed on moistened young growths of the *Thalictrum* plants. Only such "mass inoculations" were made. Incubation lasted for 24 hours. Abundant infections resulted on both species, and from these, aecidiospores were taken to inoculate seedlings of "Federation" wheat under controlled conditions. Normal uredosori were produced and yielded the uredospores which were used in the specialization studies.

*Determination of the Physiologic Forms.*

Using for comparative purposes stock cultures of the two forms of leaf rust known in Australia and designated "Australian 1" and "Australian 2", numerous cultures derived from the aecidiospores were tested on the differential set of wheat varieties used by Mains and Jackson (1926), and kindly supplied in 1927 by Dr. Mains.

The result has been the derivation of four different physiologic forms, which by repeated subculturings have been sorted out and proved to be constant. One is identical with that designated "Australian 1", which was known to be present in the uredospore stage in the material used to provide the aecidial stage. The form "Australian 2", which was also present in this material, has also been recovered but with a lesser frequency. The remaining two forms have not previously been met in Australia. Their identity has been established by repeated tests made side by side with the stock cultures of "Australian 1" and "Australian 2". Using the well-known notation (Stakman and Levine, 1922), the typical reactions shown are set out in the following table:

TABLE I.  
Comparison of typical reactions shown by 4 physiologic forms of *Puccinia triticina* on the differential wheat varieties.

Wheat Variety.	C.I. Number.	Form Australian 1.	Form Australian 2.	Form New A.	Form New B.
Malakoff .....	4898-4	0	0	1	1
Norka .....	4377-2	0	0	4	1
Unnamed .....	3756-4	4	4	4	4
Do. ....	3778	4	4	4	4
Webster .....	3780-8	0	0	4	4
Unnamed .....	3747-5	0	0	4	4
Do. ....	3779-5	4	4	4	4
Mediterranean .....	3332-3	0	0	1	1
Hussar .....	4843-2	4	4	1	1
Democrat .....	3384-1	0	0	0	0
Kawvale .....	5274-1	1	1	1	1
Thew .....		0	4	4	0

It has been pointed out previously (Waterhouse, 1929) that the American set of differentials is ineffective in separating "Australian 1" from "Australian 2", but that the Farrer variety "Thew" and certain other wheats clearly differentiate the two forms. "Australian 1" gives a sharply resistant reaction, while "Australian 2" exhibits a fully susceptible reaction. It is interesting to find that "Thew" (and the other wheats like it) also serves to separate the two new forms, as shown in Table I. "Norka" is the other variety in the set of differentials which separates the new forms.

As already stated, "mass inoculations" only were made in this work. It cannot therefore be yet said with certainty that the new forms arose from hybridization of the forms "Australian 1" and "Australian 2". Until further tests are carried out there must remain the possibility that selfing may have led to segregation of the new forms.

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*Summary.*

Experimental evidence shows that as a result of inoculating *Thalictrum* plants with a mixture of germinating teleutospores of the forms of *Puccinia triticina* designated "Australian 1" and "Australian 2", aecidia were produced. From these, cultures on wheat showed that there were four physiologic forms present, of which two have not previously been found. These new forms arose on the alternate host plant, most probably as a result of hybridization of the forms "Australian 1" and "Australian 2".

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